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(54) Transmission power control setting transmission power according to number of consecutive transmission power control bits having same value

Übertragungsleistungsregelung in der die Übertragungsleistung entsprechend der Anzahl von nacheinander empfangenen Übertragungsleistungsregelungsbits gleichen Wertes eingestellt wird

Contrôle de puissance de transmission réglant la puissance de transmission selon le nombre de bits de contrôle de puissance de transmission consécutifs ayant la même valeur

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Description

[0001] The present invention relates to a transmission power control method of a spread-spectrum communication system, and a spread-spectrum communication system employing the control method, which can be preferably applied to the transmission power control in cellular CDMA (Code Division Multiple Access) systems in radio communications.

[0002] As is well known, since a plurality of users share the same frequency band in a CDMA system, signals from the other users interfere with the signal of a user, thereby degrading the communication quality of the user. In addition, when a first mobile station near a base station and a second mobile station faraway from the base station perform communications at the same time, a transmitted signal from the first mobile station will be received at higher power by the base station, and a transmitted signal from the second mobile station will be received at lower power.

[0003] Thus, a near-far problem arises in that channel quality will be greatly degraded in communications between a base station and faraway mobile stations owing to the interference from mobile stations near the base station. In view of this, transmission power control has been studied as a technique for overcoming the near-far problem. The transmission control is carried out by controlling transmission power in such a manner that the received power by a receiving station, or the SIR (Signal-to-Interference power Ratio) obtained from the received power is kept constant independently of the locations of a mobile station, thus providing uniform channel quality throughout the service area. In particular, in reverse (from mobile station to base station) channels, the transmission power control of respective mobile stations is performed such that the received power levels of signals transmitted from the mobile stations and received by the base station, or the SIRs associated with the received power levels are kept constant at the base station.

[0004] In particular, in the CDMA system which considers the interference from the other users as white noise, equivalent noise power increases with the number of users, and hence, the capacity in terms of the number of subscribers in the cell is determined on the basis of the received SIR which can maintain predetermined channel quality.

[0005] On the other hand, in forward (from base station to mobile station) channels, the received SIR is kept constant because the intended channel signal travels through the same propagation paths as the signals for the other users which cause the interference, and undergoes the same fluctuations as the interference waves, where the fluctuations include long-term, short-term, and instantaneous fluctuations. Therefore, the transmission power control is not required when handling only the interference in the same cell.

[0006] The CDMA system, which handles the interference as white noise, however, must take account of the interference from other cells because it shares the same frequency band with adjacent cells. Although the interference power from other cells takes a form of instantaneous fluctuations due to Rayleigh fading as the interference power in the same cell, the fluctuations differ from those of the desired signal. According to the CDMA system standard by TIA (Telecommunications Industry Association), no forward transmission power control is performed basically, except when a frame error rate at a base station exceeds a predetermined threshold level, in which case the transmission power of the base station to the mobile station is increased. This is because a large amount of transmission power change will increase the interference to other cells. The transmitted signals from the base stations of other cells, however, become instantaneously fluctuating interference to an intended channel, and this conventional system cannot follow the instantaneous fluctuations.

[0007] As a conventional transmission power control method which can track the instantaneous fluctuations, a transmission power control method based on a closed loop control using a transmission power control bit is known.

[0008] Figs. 1A and 1B show examples of the transmission power control method based on the closed loop control. As shown in Figs. 1A and 1B, when a mobile station performs communications with a base station within the cell, the mobile station measures the received power of the desired signal from the base station, and determines a transmission power control bit for controlling the transmission power of the base station on the basis of the measured result (steps S1 - S4). The mobile station inserts the transmission power control bit into the signal to be transmitted, and transmits it to the base station. The base station receives the signal transmitted from the mobile station, extracts the transmission power control bit, and determines its transmission power in accordance with the transmission power control bit (steps S5 and S6).

[0009] Likewise, the base station measures the received power of the desired signal from the mobile station, and determines a transmission power control bit for controlling the transmission power of the mobile station on the basis of the measured result (steps S11 - S14). Then, the base station inserts the transmission power control bit into the signal to be transmitted, and sends it to the mobile station. The mobile station receives the signal transmitted from the base station, extracts the transmission power control bit, and determines its transmission power in accordance with the transmission power control bit (steps S15 and S16).

[0010] According to the conventional closed loop transmission power control method described above in reference to Figs. 1A and 1B, the insertion interval of the transmission power control bit must be shorter than the Doppler fluctuation period (= 1/Doppler frequency) in order to absorb the instantaneous fluctuations due to Rayleigh fading. For example, when a carrier of 2 GHz band is used by a mobile station moving at 60 km/h - 70 km/h, the Doppler frequency becomes about 200 Hz. Accordingly, the transmission power control bit must be inserted into a frame at every few

millisecond interval.

[0011] On the other hand, taking account of frame efficiency (transmission efficiency), the number of transmission power control bits per transmission power control is limited to 1 - 2 bits. Furthermore, a controlled amount is usually set small to achieve a high accuracy transmission power control. Therefore, the conventional system cannot follow a sudden changes in the received power. In particular, since there are many high buildings in urban areas, the propagation path of a mobile station may suddenly be transferred from a shadow of a high building to a line of sight area, or vice versa. In such cases, the received signal level at the base station will vary by more than 30 dB.

[0012] In the case where the transmission power control n the reverse direction operates normally as described above, the base station received powers (or SIRs) of the signals transmitted from respective mobile stations become constant, and hence, uniform receiving quality can be obtained.

[0013] However, when a mobile station suddenly moves out of a shadow of a building to a line of sight area, the base station's received power of the signal transmitted from the mobile station suddenly increases, which induces large interference to signals transmitted from the other mobile stations. In such cases, the transmission power control bit of a small controlling quantity cannot quickly reduce the transmission power. This presents a problem in that large interference to the other users takes place, and the capacity in terms of the number of subscribers is reduced.

[0014] WO-A-9221196 discloses a CDMA cellular mobile telephone system in which the transmitted power is adjusted in a mobile unit in an opposite manner with respect to increases and decreases in received signal power. The received power is measured in the mobile unit and a power adjustment command is transmitted back to the base station to control the transmitted power level.

[0015] In accordance with a first aspect, the present invention provides a method of controlling transmission power of a transmitting station for use in a spread-spectrum communication system, said transmission power control method comprising the steps of: receiving in said transmitting station a transmission power control bit sequentially from a receiving station; and controlling in said transmitting station said transmission power based on the received transmission power control bit; characterised: by storing in advance, in said transmitting station, different control quantities of a transmission power of said transmitting station, the values of which are predetermined in accordance with the number of consecutive receptions of the same value of said transmission power control bit; by detecting, in said transmitting station, the number of consecutive receptions of the same value of the transmission power control bit supplied from said receiving station; and in that the controlling step comprises controlling, in said transmitting station, each time said transmission power control bit is received, said transmission power in accordance with the stored control quantity associated with said detected number of consecutive receptions of the same value of said transmission power control bit.

[0016] In accordance with a second aspect, the present invention provides a transmitting station for use in a spread-spectrum communication system, said transmitting station comprising: means for receiving a transmission power control bit sequentially from a receiving station; and means for controlling transmission power of said transmitting station, based on the received transmission control bit; the transmitting station being characterised in comprising: means for storing in advance different control quantities of a transmission power of said transmitting station, said different control quantities being predetermined in accordance with the number of consecutive receptions of the same value of said transmission power control bit; means for detecting the number of consecutive receptions of the same value of said transmission power control bit supplied from said receiving station; and in that the means for controlling is operable to control, each time said transmission power control bit is received, said transmission power in accordance with the stored control quantities associated with said detected number of consecutive receptions of the same value of the transmission power control bit.

[0017] The control quantities may be predetermined in accordance with the number of consecutive receptions when the value of the transmission power control bit is "0" which commands a decrement of the transmission power, and the control quantities are fixed when the value of the transmission power control bit is "1" which commands an increment of the transmission power.

[0018] The control quantities may be -1 dB, -3 dB, -4 dB, and -5 dB, when the number of consecutive receptions of "0" of the transmission power control bit is 2, 3, 4, and 5 or more, respectively.

[0019] Thus large changes in the received power of the opposite party is presumed when transmission power control bits of the same value are received consecutively. In this case, transmission power control is performed in accordance with controlled quantities of the transmission power, which are predetermined in accordance with the number of consecutive receptions of the same value of the transmission power control bits during the consecutive reception interval. Thus, an increment or a decrement of the transmission power if increased with the consecutive reception time, which makes it possible to follow sudden changes in the communication paths.

[0020] Embodiments of the present invention will now be described with reference to the accompanying drawings, in which:

Figs. 1A and 1B are flowcharts explaining the principle of a conventional transmission power control method;

Figs. 2A and 2B are flowcharts showing the principle of a transmission power control method in accordance with an embodiment of the present invention;
Fig. 3 is a diagram illustrating controlled quantities of transmission power during consecutive receptions of the same value of the transmission power control bits; and
Figs 4A and 4B are block diagrams showing an embodiment of a spread-spectrum communication system in accordance with an embodiment of the present invention.

[0021] Figs. 2A and 2B illustrate, in the form of a flowchart, the operation principle and control procedure of an embodiment of the present invention.
[0022] First, referring to Figs. 2A and 2B, the transmission power control in the forward direction will be described. While a mobile station communicates with the base station in the cell, the mobile station measures the received SIR, and compares the measured result with a predetermined threshold, that is, with a reference SIR (steps S21 - S23). If the measured result is greater than the reference SIR, the mobile station transmits a transmission power control bit which commands the base station to reduce its transmission power. On the contrary, if the measured result is less than the reference SIR, the mobile station transmits a transmission power control bit which commands the base station to increase its transmission power (step S24). The transmission power control bit is inserted into a information signal in a reverse frame, and is transmitted to the base station.
[0023] The base station, receiving the signal transmitted from the mobile station, despreads and demodulates the signal, extracts the transmission power control bits from the signal sequence (step S25), and determines the transmission power in accordance with the command of the transmission power control bits (step S27, see, Table 1). If the same value of the transmission power control bit is consecutively received (YES of step S26), the transmission power control is performed in accordance with control quantities of the transmission power (see, Table 2), which are predetermined in accordance with the number of consecutive receptions of the same value of the transmission power control bits (step S28).

TABLE 1

TRANSMISSION POWER CONTROL BIT	TRANSMISSION POWER CONTROL AMOUNT
0	-1 dB
1	+1 dB

TABLE 2

CONSECUTIVE NUMBER OF "0" BITS	TRANSMISSION POWER CONTROL AMOUNT
2	-1 dB (NORMAL)
3	-3 dB
4	-4 dB
5 OR MORE	-5 dB
"1" BITS COMMAND +1 dB INDEPENDENTLY OF THE NUMBER OF CONSECUTIVE BITS	

[0024] Next, the transmission power control in the reverse direction will be described. The base station measures the received SIR, and determines the transmission power control bit for controlling the transmission power of the mobile station on the basis of the measured result (steps S31 - S34).
Then, the base station inserts the transmission power control bit into a transmitted signal, and sends it to the mobile station. The mobile station, receiving the signal transmitted from the base station, despreads and demodulates the signal, extracts the transmission power control bit from the signal sequence (step S35), and determines the transmission power in accordance with the command of the transmission power control bit (step S37, see, Table 1). If the same value of the transmission power control bits is consecutively received (step S36), the transmission power control is performed in accordance with control quantities of the transmission power, which are predetermined in accordance with the number of consecutive receptions of the same value of the transmission power control bits (step S38) (see, Table 2).
[0025] Thus, the transmission power control bit consists of one bit in this embodiment, and the normal transmission power control quantity is determined in accordance with Table 1. However, the transmission power control quantities

are changed as shown in Table 2, when the same value of the transmission power control bits is received successively.

[0026] For example, when a transmission power control bit train as shown at the top of Fig. 3 is received, the transmission power control is carried out as shown in this figure. In this case, the normal transmission power control is performed even if the transmission power control bit "1" is received consecutively. The consecutive "0"s at the last portion of the transmission power control bit train will provide -3 dB at three consecutive bits, -4 dB at four consecutive bits, -5 dB at five consecutive bits, and -5 dB at six consecutive bits. Thus, the transmission power is substantially reduced in a short time.

[0027] Therefore, when the mobile station suddenly comes out of the shadow of a building, and the received power increases quickly, the transmission power is reduced by 19 dB in six transmission power control periods. This makes it possible to follow sudden changes in the communication paths.

[0028] Figs. 4A and 4B are block diagrams showing an embodiment of a spread-spectrum communication system in accordance with the present invention. In Figs. 4A and 4B, the reference numeral 10 designates an antenna, the reference numeral 11 designates a diplexer, the reference numeral 12 designates an RF receiver, the reference numeral 13 designates a despreader, the reference numeral 14 designates a demodulator, the reference numeral 15 designates a transmission power control bit extractor, the reference numeral 16 designates a transmission power controller, the reference numeral 17 designates a desired wave received power detector, the reference numeral 18 designates an interference wave received power detector, the reference numeral 19 designates an SIR calculator, the reference numeral 20 designates a transmission power control bit decision portion, the reference numeral 21 designates a signal generator, the reference numeral 22 designates a modulator, the reference numeral 23 designates a spreader, and the reference numeral 24 designates an RF transmitter.

[0029] Next, the operation of the embodiment will be described assuming that the system of Figs. 4A and 4B is a mobile station. A spread-spectrum signal transmitted from a base station is received by the antenna 10. The received signal is inputted to the RF receiver 12 via the diplexer 11. In the RF receiver 12, the received signal is passed through a bandpass filter to remove components out of the pass band, amplified by an amplifier, and down-converted to an intermediate frequency (IF) signal by a local signal generated by a local oscillator. The IF signal is passed through a bandpass filter, and its level is corrected to an appropriate signal level by an automatic gain control circuit (AGC). The output of the AGC undergoes a quasi-coherent detection, and is frequency-converted into a baseband signal. The baseband signal is passed though a lowpass filter, undergoes an analog-to-digital (A/D) conversion, and is outputted as a digital signal.

[0030] The digital signal outputted from the RF receiver 12 is despread by the despreader 13, and is outputted as a narrow band modulated signal. The modulated signal is demodulated by the demodulator 14. The demodulated signal is supplied to the transmission power control bit extractor 15 which extracts a transmission power control bit from the demodulated signal. The transmission power controller 16 is provided with a consecutive number counter 16A which counts the consecutive number by counting up its value when the extracted transmission power control bit is identical to the preceding one. Thus, the number of consecutive identical transmission power control bits is detected. In addition, the transmission power controller 16 determines the transmission power control quantity associated with the value of the transmission power control bits and their consecutive number as shown in Table 2, and provides the RF transmitter 24 with control information. Control tables corresponding to Tables 1 and 2 are stored in a ROM in the transmission power controller 16.

[0031] On the other hand, the desired wave received power detector 17 and the interference wave received power detector 18 in the despreader 13 detect the desired wave received power and the interference wave received power, respectively, on the basis of which the SIR calculator 19 obtains the received SIR. The transmission power control bit decision portion 20 compares the received SIR with a predetermined reference SIR, produces a control bit which commands an increase in the transmission power of the base station when the received SIR is less than the reference SIR, or a decrease in the transmission power when the received SIR is greater than the reference SIR, and supplies the control bit to the signal generator 21.

[0032] The signal generator 21 forms a frame to be transmitted including the transmission power control bit supplied from the transmission power control bit decision portion 20, and provides it to the modulator 22. The signal to be transmitted is modulated by the modulator 22, despread by the despreader 23, and is supplied to the RF transmitter 24. The transmitted signal which is frequency converted to an RF band by the RF transmitter 24 is transmitted at transmission power based on the control information outputted from the transmission power controller 16.

[0033] Although it is assumed that the system of Figs. 4A and 4B is a mobile station, the system can be a base station which operates in a similar way.

Claims

1. A method of controlling transmission power of a transmitting station for use in a spread-spectrum communication

system, said transmission power control method comprising the steps of:

receiving in said transmitting station a transmission power control bit sequentially from a receiving station; and controlling in said transmitting station said transmission power based on the received transmission power control bit;

characterised:

by storing in advance, in said transmitting station, different control quantities of a transmission power of said transmitting station, the values of which are predetermined in accordance with the number of consecutive receptions of the same value of said transmission power control bit;
by detecting, in said transmitting station, the number of consecutive receptions of the same value of the transmission power control bit supplied from said receiving station (525;536); and
in that the controlling step comprises controlling, in said transmitting station, each time said transmission power control bit is received, said transmission power in accordance with the stored control quantity associated with said detected number of consecutive receptions of the same value of said transmission power control bit (528; 537).

2. The transmission power control method as claimed in claim 1, further comprising the steps of:

detecting, in said receiving station, received power of a desired wave (521;531);
detecting, in said receiving station, received power of an interference wave (521;531);
calculating, in said receiving station, a received signal-to-interference ratio of said received power of a desired wave to said received power of an interference wave (522;532); and
determining, in said receiving station, said transmission power control bit such that said received signal-to-interference ratio becomes equal to a predetermined reference signal-to-interference ratio (524;534).

3. The transmission power control method as claimed in claim 1, wherein said different control quantities are predetermined in accordance with said number of consecutive receptions of the value of said transmission power control bit being "0", which commands a decrement of said transmission power, and said control quantities are set at the same value when the value of said transmission power control bit is "1" which commands an increment of said transmission power.

4. The transmission power control method as claimed in claim 3, wherein said control quantity is, respectively, -1 dB, -3 dB, -4 dB, and -5 dB, corresponding to the number of consecutive receptions of "0" of said transmission power control bit being 2, 3, 4 and 5 or more.

5. A transmitting station for use in a spread-spectrum communication system, said transmitting station comprising:

means (10-15) for receiving a transmission power control bit sequentially from a receiving station; and
means (16) for controlling transmission power of said transmitting station, based on the received transmission control bit;
the transmitting station being **characterised in** comprising:

means for storing in advance different control quantities of a transmission power of said transmitting station, said different control quantities being predetermined in accordance with the number of consecutive receptions of the same value of said transmission power control bit;
means (16A) for detecting the number of consecutive receptions of the same value of said transmission power control bit supplied from said receiving station; and

in that the means (16) for controlling is operable to control, each time said transmission power control bit is received, said transmission power in accordance with the stored control quantities associated with said detected number of consecutive receptions of the same value of the transmission power control bit.

6. A station as claimed in claim 5, wherein said storage means is operable to store said different power control quantities predetermined in accordance with said number of consecutive receptions of the value of said transmission power control bit being "0", which commands a decrement of said transmission power, and to store the same power control quantity set at the same value when the value of said transmission power control bit is "1" which

commands an increment of said transmission power.

7. A station as claimed in claim 6, wherein said storage means is operable to store a power control quantity, respectively of value -1 dB, -3 dB, -4 dB, and - 5 dB, corresponding to the number of consecutive receptions of "0" of said transmission power control being 2, 3, 4 and 5 or more.

8. A spread-spectrum communication system comprising a transmitting station in accordance with any of claims 5 to 7, and a receiving station.

9. A system in accordance with claim 8, wherein said receiving station comprises:

means (17) for detecting received power of a desired wave;
means (18) for detecting received power of an interference wave;
means (19) for calculating a received signal-to-interference ratio of said received power of a desired wave to said received power of an interference wave; and
means (20) for determining a transmission power control bit for equalizing said received signal-to-interference ratio to a predetermined reference signal-to-interference ratio.

Patentansprüche

1. Verfahren zum Steuern der Sendeleistung einer Sendestation zur Verwendung bei einem Spreizspektrums-Kommunikationssystem, mit den Schritten des
in der Sendestation Empfangens eines Sendeleistungs-Steuerbits sequentiell von einer Empfangsstation, und
in der Sendestation Steuerns der Sendeleistung auf der Grundlage des empfangenen Sendeleistungs-Steuerbits,
gekennzeichnet
durch in der Sendestation im Voraus Speichern von verschiedenen Steuermengen einer Sendeleistung der Sendestation, deren Werte gemäß der Anzahl von aufeinanderfolgenden Empfängen des selben Werts des Sendeleistungs-Steuerbits vorbestimmt sind,
durch in der Sendestation Erfassen der Anzahl von aufeinanderfolgenden Empfängen des selben Werts des von der Empfangsstation zugeführten Sendeleistungs-Steuerbits (525; 536), und
dadurch, dass der Steuerschritt umfasst, jedes Mal, wenn das Sendeleistungs-Steuerbits empfangen wird, in der Sendestation Steuern der Sendeleistung gemäß der gespeicherten Steuermenge, die mit der erfassten Anzahl von aufeinanderfolgenden Empfängen des selben Werts des Sendeleistungs-Steuerbits in Zusammenhang steht (528; 537).

2. Sendeleistungs-Steuerverfahren nach Anspruch 1, zudem mit den Schritten des
in der Empfangsstation Erfassens von empfangener Leistung einer gewünschten Welle (521; 531),
in der Empfangsstation Erfassens von empfangener Leistung einer Störwelle (521; 531),
in der Empfangsstation Berechnens eines empfangenen Signal-Stör-Verhältnisses der empfangenen Leistung einer gewünschten Welle zu der empfangenen Leistung einer Störwelle (522; 532), und
in der Empfangsstation Bestimmens des Sendeleistungs-Steuerbits derart, dass das empfangene Signal-Stör-Verhältnis gleich einem vorbestimmten Bezugs-Signal-Stör-Verhältnis wird (524; 534).

3. Sendeleistungs-Steuerverfahren nach Anspruch 1, wobei die verschiedenen Steuermengen gemäß der Anzahl von aufeinanderfolgenden Empfängen des Werts des Sendeleistungs-Steuerbits mit dem Wert "0" vorbestimmt sind, was eine Verminderung der Sendeleistung befiehlt, und die Steuermengen auf den selben Wert gesetzt werden, wenn der Wert des Sendeleistungs-Steuerbits "1" beträgt, was eine Erhöhung der Sendeleistung befiehlt.

4. Sendeleistungs-Steuerverfahren nach Anspruch 3, wobei die Steuermenge entsprechend der 2, 3, 4 und 5 oder mehr betragenden Anzahl von aufeinanderfolgenden Empfängen des Sendeleistungs-Steuerbits mit dem Wert "0" jeweils -1 dB, -3 dB, -4 dB und -5 dB beträgt.

5. Sendestation zur Verwendung bei einem Spreizspektrums-Kommunikationssystem, mit
einer Einrichtung (10 - 15) zum Empfang eines Sendeleistungs-Steuerbits sequentiell von einer Empfangsstation, und

einer Einrichtung (16) zur Steuerung der Sendeleistung der Sendestation auf der Grundlage des empfangenen Sendeleistungs-Steuerbits,

gekennzeichnet durch

eine Einrichtung zur im Voraus Speicherung von verschiedenen Steuermengen einer Sendeleistung der Sendestation, wobei die verschiedenen Steuermengen gemäß der Anzahl von aufeinanderfolgenden Empfängen des selben Werts des Sendeleistungs-Steuerbits vorbestimmt sind,

eine Einrichtung (16A) zur Erfassung der Anzahl von aufeinanderfolgenden Empfängen des selben Werts des von der Empfangsstation zugeführten Sendeleistungs-Steuerbits, und

dadurch, dass die Einrichtung (16) zur Steuerung betreibbar ist, um jedes Mal, wenn das Sendeleistungs-Steuerbit empfangen wird, die Sendeleistung gemäß den gespeicherten Steuermengen zu steuern, die mit der erfassten Anzahl von aufeinanderfolgenden Empfängen des selben Werts des Sendeleistungs-Steuerbits in Zusammenhang stehen.

6. Station nach Anspruch 5, wobei die Speichereinrichtung betreibbar ist, um die verschiedenen Leistungssteuermengen zu speichern, die gemäß der Anzahl von aufeinanderfolgenden Empfängen des Werts des Sendeleistungs-Steuerbits mit dem Wert "0" vorbestimmt sind, was eine Verminderung der Sendeleistung befiehlt, und die auf den selben Wert gesetzte selbe Leistungssteuermenge zu speichern, wenn der Wert des Sendeleistungs-Steuerbits "1" beträgt, was eine Erhöhung der Sendeleistung befiehlt.

7. Station nach Anspruch 6, wobei die Speichereinrichtung betreibbar ist, um eine Leistungssteuermenge, die jeweils einen Wert -1 dB, -3 dB, -4 dB und -5 dB aufweist, entsprechend der 2, 3, 4 und 5 oder mehr betragenden Anzahl von aufeinanderfolgenden Empfängen des Sendeleistungs-Steuerbits mit dem Wert "0" zu speichern.

8. Spreizspektrums-Kommunikationssystem mit einer Sendestation gemäß einem der Ansprüche 5 bis 7, und einer Empfangsstation.

9. System nach Anspruch 8, wobei die Empfangsstation umfasst

   eine Einrichtung (17) zur Erfassung von empfangener Leistung einer gewünschten Welle,

   eine Einrichtung (18) zur Erfassung von empfangener Leistung einer Störwelle,

   eine Einrichtung (19) zur Berechnung eines empfangenen Signal-Stör-Verhältnisses der empfangenen Leistung einer gewünschten Welle zu der empfangenen Leistung einer Störwelle, und

   eine Einrichtung (20) zur Bestimmung eines Sendeleistungs-Steuerbits zum Abgleichen des empfangenen Signal-Stör-Verhältnis mit einem vorbestimmten Bezugs-Signal-Stör-Verhältnis.

Revendications

1. Procédé pour commander la puissance de transmission d'un poste émettant pour l'utilisation dans un système de communication à spectre large, le procédé de commande de puissance de transmission comportant les étapes qui consistent :

   à recevoir au poste d'émission un bit de commande de puissance d'émission en séquence à partir d'un poste de réception ; et

   à commander dans le poste d'émission la puissance d'émission sur la base du bit de commande de puissance d'émission reçu ;

   caractérisé,

   par le fait de mémoriser à l'avance, dans le poste d'émission, différentes quantités de commande d'une puissance de transmission du poste d'émission, dont les valeurs sont déterminées à l'avance conformément au nombre de réceptions consécutives de la même valeur du bit de commande de puissance d'émission ;

   par le fait détecter, au poste d'émission, le nombre de réceptions consécutives de la même valeur du bit de commande de puissance d'émission fourni par le poste (525 ; 536) de réception ; et

   en ce que l'étape de commande comporte l'étape qui consiste à commander, au poste d'émission, chaque fois que le bit de commande de puissance d'émission est reçu, la puissance d'émission conformément aux quantités de commande mémorisées associées au nombre détecté de réceptions consécutives de la même valeur du bit (528 ; 537) de commande de puissance d'émission.

2. Procédé de commande de puissance d'émission suivant la revendication 1, comportant en outre les étapes qui

consistent :

à détecter, au poste de réception, la puissance reçue d'une onde souhaitée (521 ; 531) ;
à détecter, au poste de réception, la puissance reçue d'une onde (521 ; 531) d'interférence ;
à calculer, au poste de réception, un rapport signal à interférence reçu de la puissance reçue d'une onde souhaitée par rapport à la puissance reçue d'une onde d'interférence (522 ; 532) ; et
à déterminer au poste de réception, le bit de commande de puissance d'émission de sorte que le rapport signal à interférence reçu devient égal à un rapport signal à interférence (524 ; 534) de référence déterminé à l'avance.

3. Procédé de commande de puissance d'émission suivant la revendication 1, dans lequel les différentes quantités de commande sont déterminées à l'avance conformément au nombre de réceptions consécutives de la valeur du bit de commande de puissance d'émission égale à "0", ce qui commande une diminution de la puissance d'émission, et les quantités de commande sont réglées à la même valeur lorsque la valeur du bit de commande de puissance d'émission est égale à "1", ce qui commande une augmentation de la puissance d'émission.

4. Procédé de commande de puissance d'émission suivant la revendication 3, dans lequel la quantité de commande est respectivement - 1 dB, -3 dB, -4 dB et -5 dB, correspondant à un nombre de réceptions consécutives de "0" du bit de commande de puissance d'émission qui est égal à 2, 3, 4 et 5 ou plus.

5. Poste d'émission pour l'utilisation dans un système de communication à spectre large, le poste d'émission comportant :

des moyens (10-15) destinés à recevoir un bit de commande de puissance d'émission en séquence à partir d'un poste de réception ; et
des moyens (16) destinés à commander la puissance d'émission du poste émetteur, sur la base du bit de commande d'émission reçu ;
le poste émetteur étant **caractérisé par** le fait de comporter :

des moyens destinés à mémoriser à l'avance différentes quantités de commande d'une puissance d'émission du poste émetteur, les différentes quantités de commande étant déterminées à l'avance conformément au nombre de réceptions consécutives de la même valeur du bit de commande de puissance d'émission ;
des moyens (16A) destinés à détecter le nombre de réceptions consécutives de la même valeur du bit de commande de puissance d'émission fourni par le poste de réception ; et
en ce que les moyens (16) destinés à commander peuvent être actionnés pour commander, chaque fois que le bit de commande de puissance d'émission est reçu, la puissance d'émission conformément aux quantités de commande mémorisées associées au nombre détecté de réceptions consécutives de la même valeur du bit de commande de puissance d'émission.

6. Poste suivant la revendication 5, dans lequel les moyens de mémorisation peuvent être actionnés pour mémoriser les différentes quantités de commande de puissance déterminées à l'avance conformément au nombre de réceptions consécutives de la valeur du bit de commande de puissance d'émission égale à "0", qui commande une diminution de la puissance d'émission, et pour mémoriser la même quantité de commande de puissance réglée à la même valeur lorsque la valeur du bit de commande de puissance d'émission est "1", ce qui commande une augmentation de la puissance d'émission.

7. Poste suivant la revendication 6, dans lequel les moyens de mémorisation peuvent être actionnés pour mémoriser une quantité de commande de puissance respectivement de valeur -1 dB, -3 dB, -4 dB et - 5 dB, correspondant à un nombre de réceptions consécutives de "0" de la commande de puissance d'émission qui est égal à 2, 3, 4 et 5 ou plus.

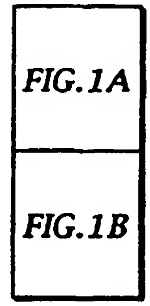
8. Système de communication à spectre large comportant un poste d'émission conformément à l'une quelconque des revendications 5 à 7, et un poste de réception.

9. Système suivant la revendication 8, dans lequel le poste de réception comporte :

des moyens (17) destinés à détecter de la puissance reçue d'une onde souhaitée ;

des moyens (18) destinés à détecter de la puissance reçue d'une onde d'interférence ;
des moyens (19) destinés à calculer un rapport signal à interférence reçu de la puissance reçue d'une onde souhaitée à la puissance reçue d'une onde d'interférence ; et
des moyens (20) destinés à déterminer un bit de commande de puissance d'émission pour égaliser le rapport signal à interférence reçu à un rapport signal à interférence de référence déterminé à l'avance.

FIG.1



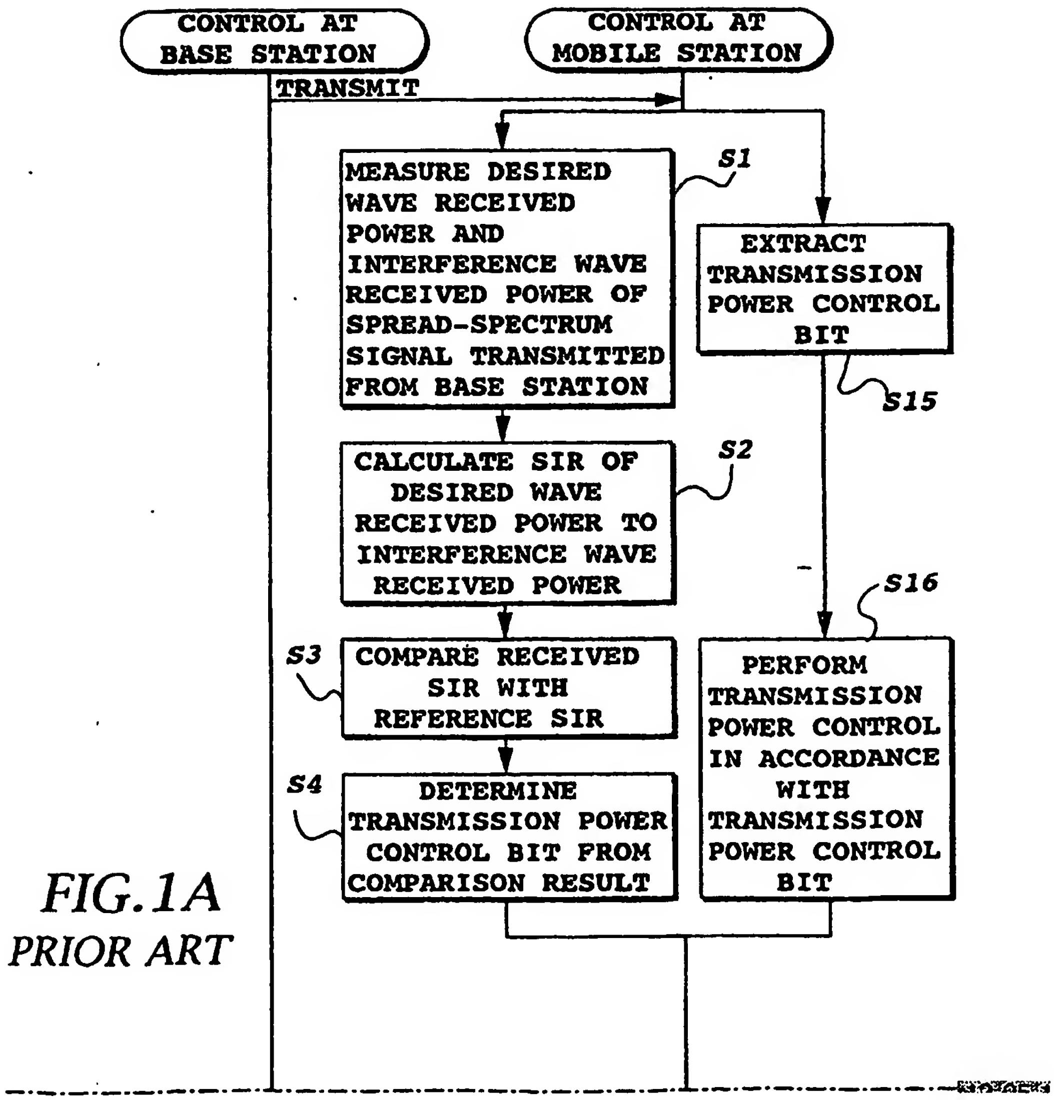


FIG.1A
PRIOR ART

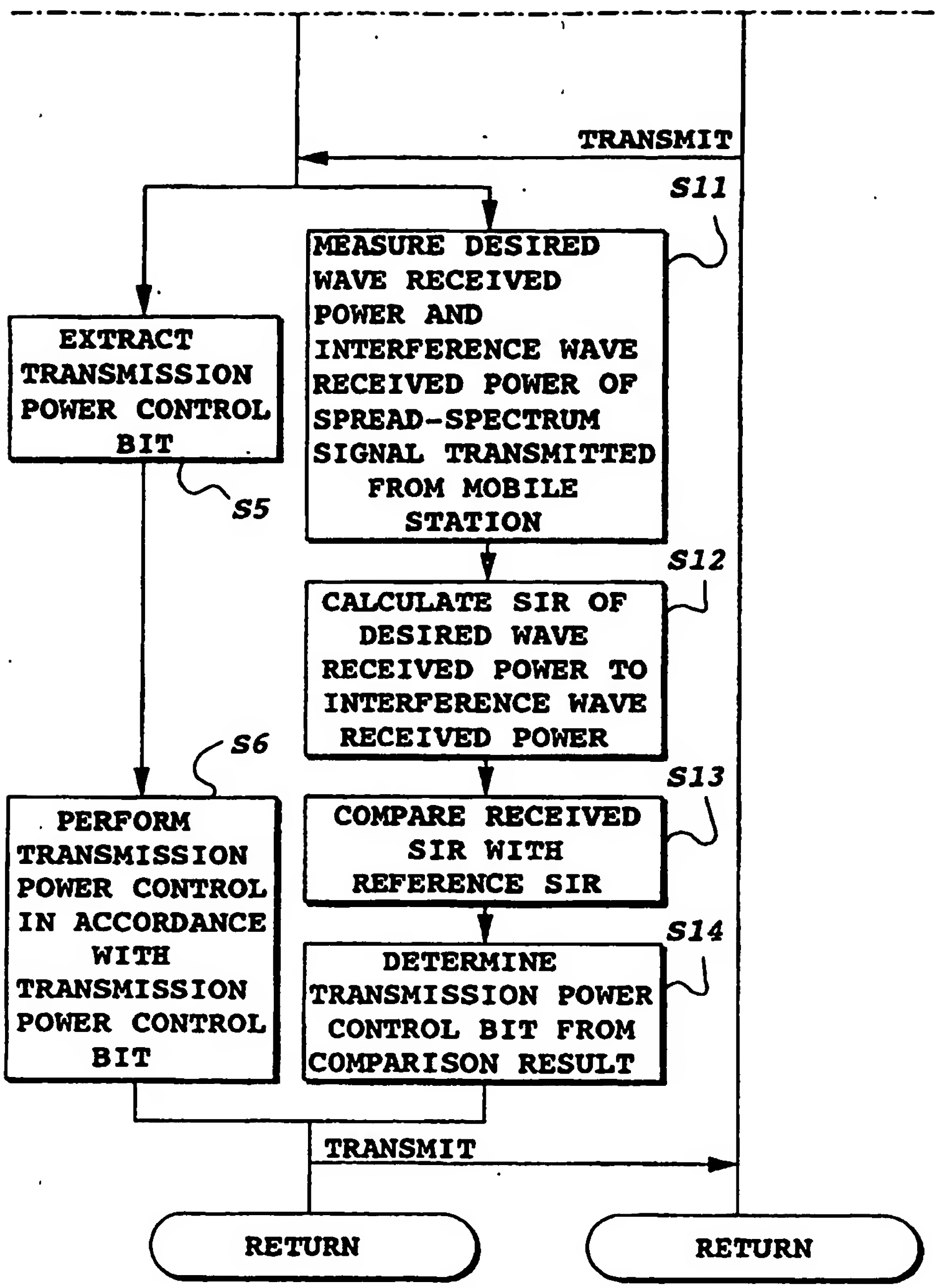


FIG.1B
PRIOR ART

FIG.2

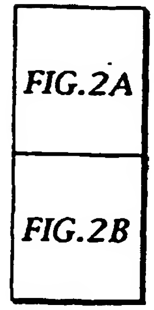


FIG.2A
FIG.2B

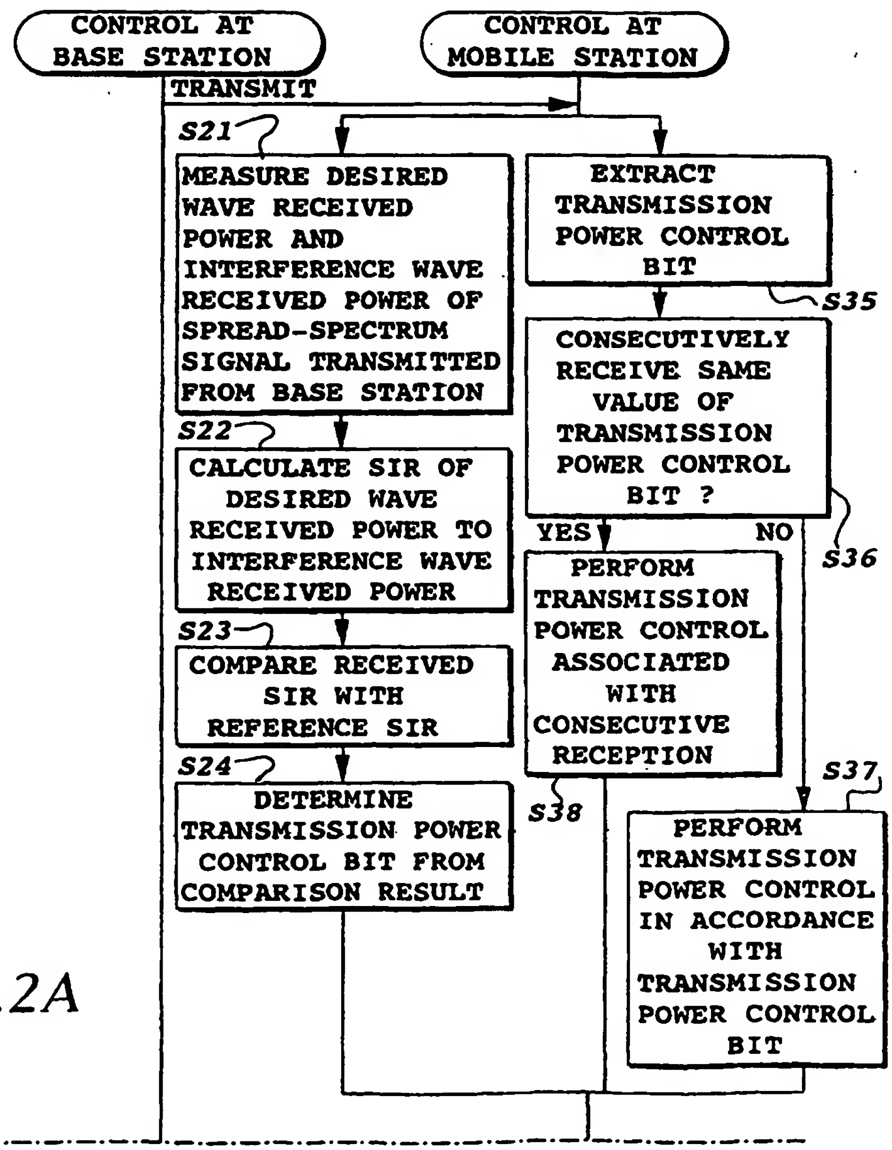

CONTROL AT BASE STATION
CONTROL AT MOBILE STATION
TRANSMIT
S21
MEASURE DESIRED WAVE RECEIVED POWER AND INTERFERENCE WAVE RECEIVED POWER OF SPREAD-SPECTRUM SIGNAL TRANSMITTED FROM BASE STATION
S22
CALCULATE SIR OF DESIRED WAVE RECEIVED POWER TO INTERFERENCE WAVE RECEIVED POWER
S23
COMPARE RECEIVED SIR WITH REFERENCE SIR
S24
DETERMINE TRANSMISSION POWER CONTROL BIT FROM COMPARISON RESULT
EXTRACT TRANSMISSION POWER CONTROL BIT
S35
CONSECUTIVELY RECEIVE SAME VALUE OF TRANSMISSION POWER CONTROL BIT ?
S36
YES
NO
PERFORM TRANSMISSION POWER CONTROL ASSOCIATED WITH CONSECUTIVE RECEPTION
S38
S37
PERFORM TRANSMISSION POWER CONTROL IN ACCORDANCE WITH TRANSMISSION POWER CONTROL BIT

FIG.2A

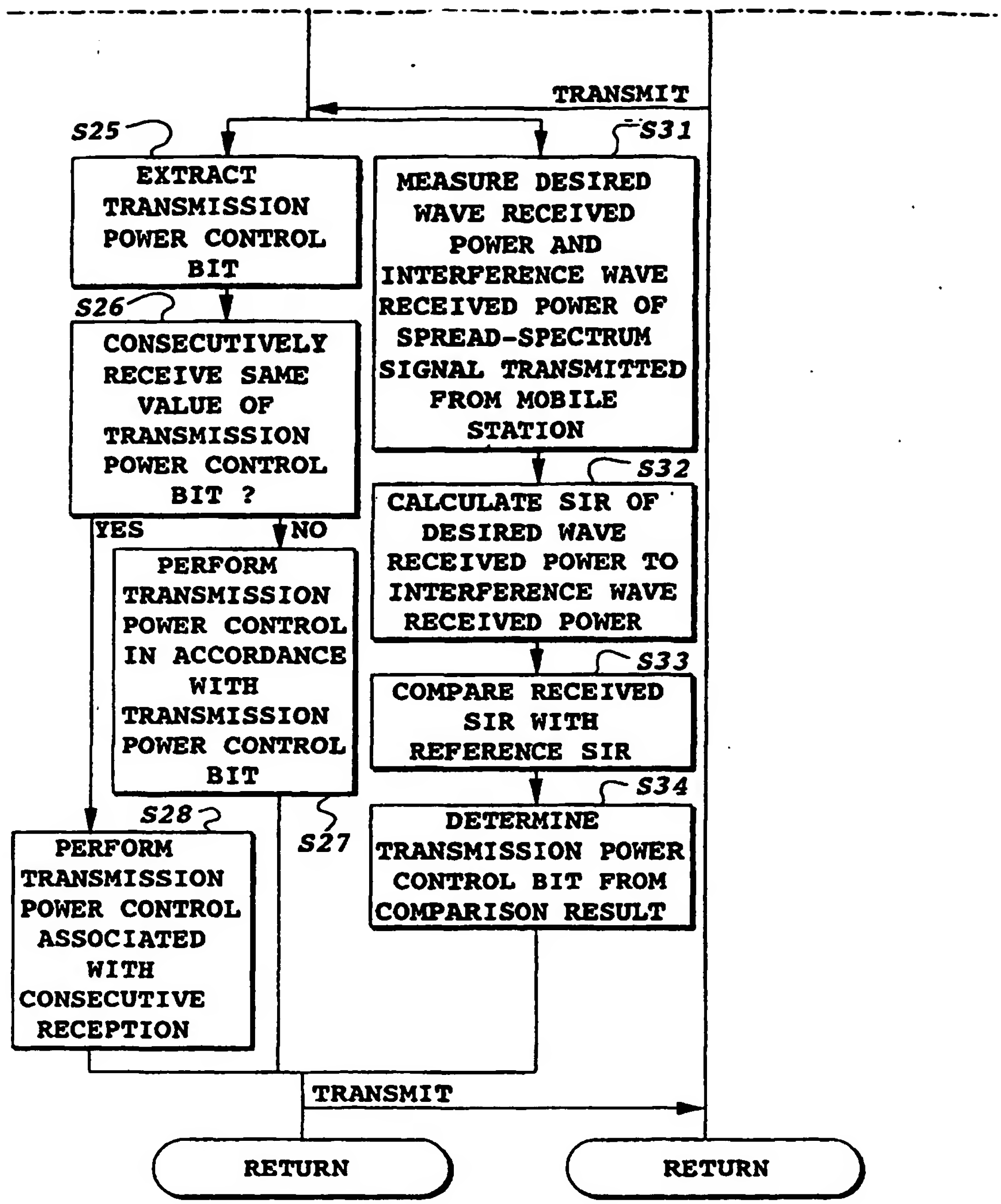

TRANSMIT
S25
EXTRACT TRANSMISSION POWER CONTROL BIT
S26
CONSECUTIVELY RECEIVE SAME VALUE OF TRANSMISSION POWER CONTROL BIT ?
YES
NO
PERFORM TRANSMISSION POWER CONTROL IN ACCORDANCE WITH TRANSMISSION POWER CONTROL BIT
S27
S28
PERFORM TRANSMISSION POWER CONTROL ASSOCIATED WITH CONSECUTIVE RECEPTION
S31
MEASURE DESIRED WAVE RECEIVED POWER AND INTERFERENCE WAVE RECEIVED POWER OF SPREAD-SPECTRUM SIGNAL TRANSMITTED FROM MOBILE STATION
S32
CALCULATE SIR OF DESIRED WAVE RECEIVED POWER TO INTERFERENCE WAVE RECEIVED POWER
S33
COMPARE RECEIVED SIR WITH REFERENCE SIR
S34
DETERMINE TRANSMISSION POWER CONTROL BIT FROM COMPARISON RESULT
TRANSMIT
RETURN
RETURN

FIG.2B

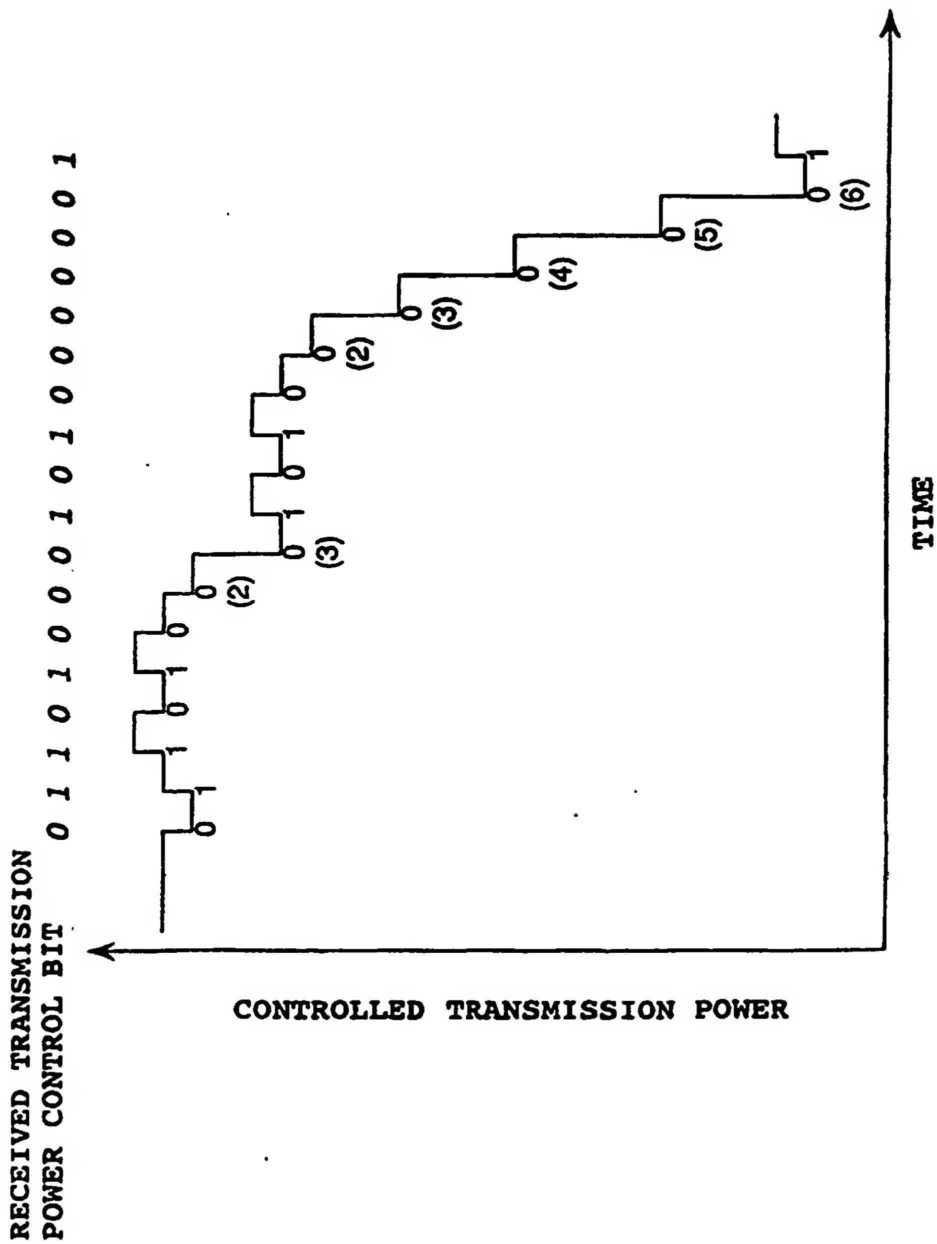

RECEIVED TRANSMISSION
POWER CONTROL BIT
0 1 1 0 1 0 0 0 1 0 1 0 0 0 0 0 0 1
(2)
(3)
(2)
(3)
(4)
(5)
(6)
CONTROLLED TRANSMISSION POWER
TIME

FIG.3

FIG.4

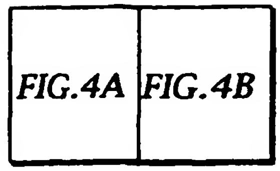


FIG.4A
FIG.4B

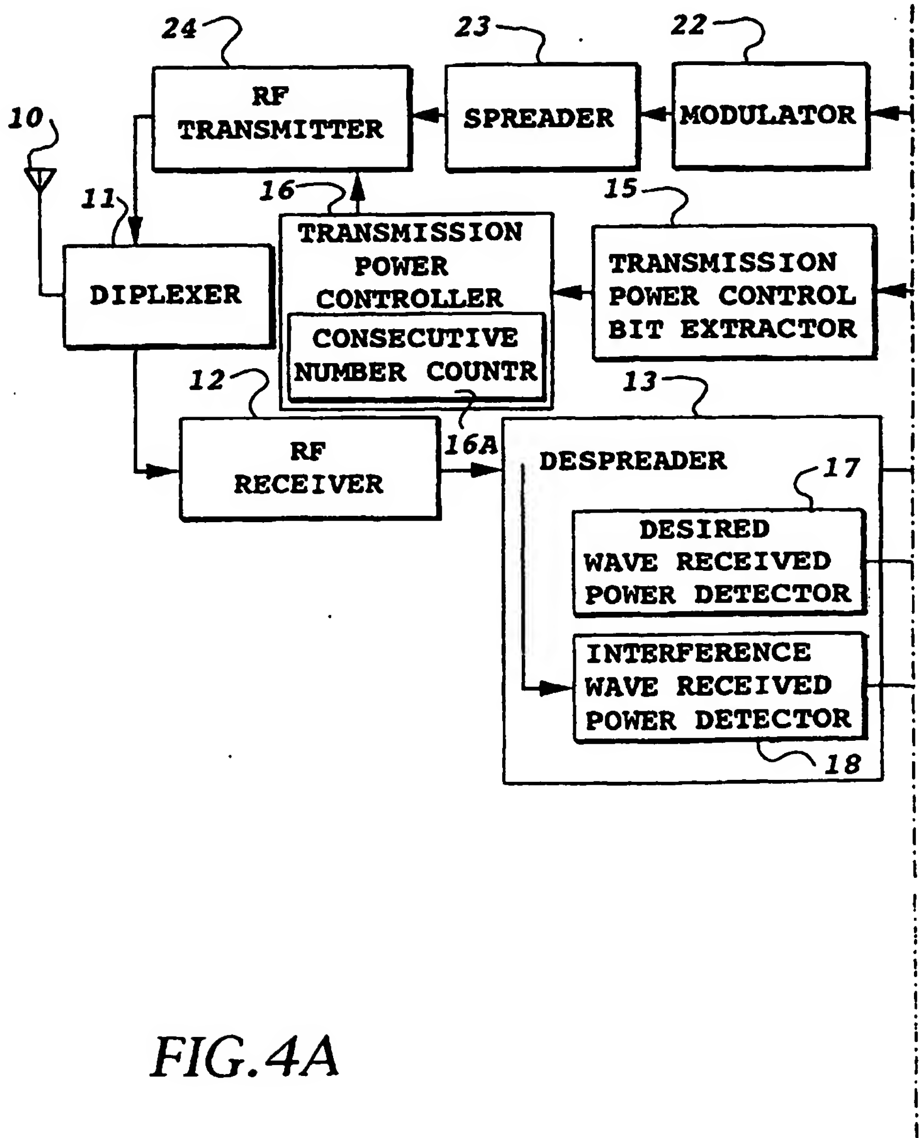

24
23
22
RF TRANSMITTER
SPREADER
MODULATOR
10
11
16
15
DIPLEXER
TRANSMISSION POWER CONTROLLER
CONSECUTIVE NUMBER COUNTR
TRANSMISSION POWER CONTROL BIT EXTRACTOR
12
13
16A
RF RECEIVER
DESPREADER
17
DESIRED WAVE RECEIVED POWER DETECTOR
INTERFERENCE WAVE RECEIVED POWER DETECTOR
18

FIG.4A

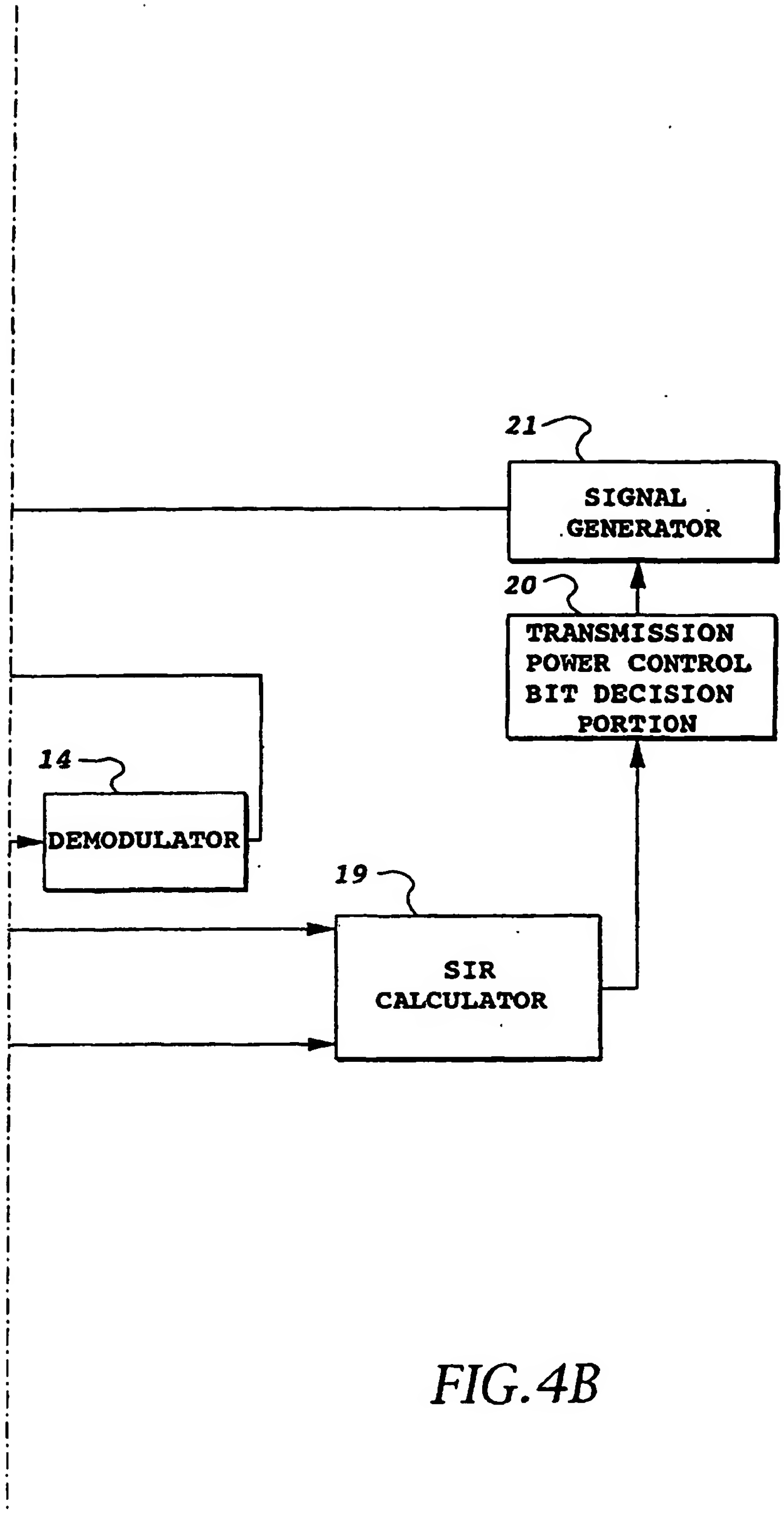

21
SIGNAL GENERATOR
20
TRANSMISSION POWER CONTROL BIT DECISION PORTION
14
DEMODULATOR
19
SIR CALCULATOR

FIG.4B